CLAIMS

Therefore, the following is claimed.

1. A fuel cell, comprising:
   a membrane comprising a material selected from organic conducting materials, inorganic conducting materials, and combinations thereof, wherein the membrane has a thickness of about 0.01 to 10 μm, and wherein the membrane has an area resistivity of about 0.1 to 1000 ohms cm^2.

2. The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 5 μm.

3. The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 2 μm.

4. The fuel cell of claim 1, wherein the membrane has an area resistivity of about 1 to 100 ohms cm^2.

5. The fuel cell of claim 1, wherein the membrane has an area resistivity of about 1 to 10 ohms cm^2.

6. The fuel cell of claim 1, wherein the material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof.

7. The fuel cell of claim 6, wherein the doped silicon dioxide is selected from phosphorous doped silicon dioxide, boron doped silicon dioxide, and combinations thereof.

8. The fuel cell of claim 1, further comprising a catalyst disposed on a first side of the membrane, wherein the catalyst is selected from platinum, platinum/ruthenium, nickel, tellurium, titanium, alloys of each, and combinations thereof.

9. The fuel cell of claim 8, further comprising a polymer layer on a second side of the membrane, wherein the polymer layer has a catalyst disposed on the side opposite the membrane.

10. The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 2 μm and wherein the membrane has an area resistivity of about 1 to 10 ohms cm^2.

11. A micro-fuel cell, comprising:

a substrate having anode current collectors disposed thereon;

a membrane disposed on the anode current collectors, wherein the membrane comprises a material selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof,

wherein the membrane has a thickness of about 0.01 to 10 μm, and wherein the membrane has an area resistivity of about 0.1 to 1000 ohms cm^2;

a hollow channel substantially defined by a portion of the substrate and a portion of the membrane, wherein at least one catalyst layer is exposed to the channel, wherein the anode current collector is disposed adjacent the channel;

a cathode current collector disposed on the membrane on the side opposite the substrate;

wherein there is an electrically conductive path between the catalyst layer and the anode current collector.

12. The micro-fuel cell of claim 11, wherein the catalyst layer comprises a first porous catalyst layer disposed on a first side of the membrane facing the substrate, wherein the first porous catalyst layer is exposed within the channel, wherein there is an electrically conductive path between the first porous catalyst layer and the anode current collector.

13. The micro-fuel cell of claim 12, wherein the catalyst layer is disposed on the substrate exposed within the channel, wherein there is an electrically conductive path between the catalyst layer, the first porous catalyst layer, and the anode current collector.

14. The micro-fuel cell of claim 11, wherein the catalyst layer comprises a catalyst layer disposed on the substrate exposed within the channel, wherein there is an electrically conductive path between the catalyst layer and the anode current collector.

15. The micro-fuel cell of claim 11, further comprising a second porous catalyst layer disposed on the membrane on the side opposite the substrate, wherein there is an electrically conductive path between the cathode current collector and the second porous catalyst layer.

16. The micro-fuel cell of claim 15, further comprising a polymer layer disposed on the side of the membrane opposite the substrate, wherein the cathode current collector and the second porous catalyst layer are disposed on the polymer layer.

17. The micro-fuel cell of claim 16, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.

18. The micro-fuel cell of claim 11, wherein the catalyst layer includes catalysts selected from platinum, platinum/ruthenium, nickel, tellurium, titanium, alloys thereof, and combinations thereof.

19. The micro-fuel cell of claim 11, wherein the wherein the membrane has a thickness of about 0.1 to 5 μm and wherein the membrane has an area resistivity of about 1 to 100 ohms cm^2.

20. A method for fabricating a micro-fuel cell, comprising:

providing a substrate having an anode current collector disposed thereon;

disposing a sacrificial polymer layer onto the substrate and the anode current collector;

removing portions of the sacrificial material not disposed on the anode current collector to form sacrificial material portions;

disposing a first porous catalyst layer onto the sacrificial material portions;

disposing a layer of a membrane material onto the sacrificial material portions, the first porous catalyst layer, and the anode current collector, wherein the membrane material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof; and

removing the sacrificial material portions to form hollow channels substantially defined by the substrate, membrane material, and the first porous catalyst layer.

21. The method of claim 20, further comprising:

disposing a second porous catalyst layer onto a top portion of the membrane material on the opposite side of the membrane material as the substrate; and

disposing a cathode current collector onto portions of the second porous catalyst layer.

22. The method of claim 20, further comprising:

disposing a polymer layer onto the membrane material;

disposing a second porous catalyst layer onto a top portion of the polymer layer on the opposite side of the polymer layer as the membrane layer; and

disposing a cathode current collector onto portions of the second porous catalyst layer.

23. The method of claim 20, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.

24. The method of claim 20, further comprising:

providing a catalyst layer on portions of the substrate, wherein the catalyst layer is disposed on portions of the substrate between the sacrificial material portions and the substrate.

25. The method of claim 20, wherein the sacrificial material is selected from polyimides, polynorbornenes, epoxides, polyarylenes ethers, polyarylenes, inorganic glasses, and combinations thereof.

26. A method for fabricating a micro-fuel cell, comprising:

providing a substrate having an anode current collector disposed thereon and a catalyst layer disposed thereon, wherein the anode current collector and the catalyst layer are adjacent one another;

disposing a sacrificial polymer layer onto the substrate, the anode current collector, and the catalyst layer;

removing portions of the sacrificial material not disposed on the anode current collector to form sacrificial material portions disposed on the catalyst layer;

disposing a layer of a membrane material onto the sacrificial material portions and the anode current collector, wherein the membrane material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof; and

removing the sacrificial material portions to form hollow channels substantially defined by the substrate, membrane material, and the catalyst layer.

27. The method of claim 26, further comprising:

disposing a first porous catalyst layer onto the sacrificial material portions prior to disposing the membrane material.

28. The method of claim 26, further comprising:

disposing a second porous catalyst layer onto a top portion of the membrane material on the opposite side of the membrane material as the substrate; and

disposing a cathode current collector onto portions of the second porous catalyst layer.

29. The method of claim 26, further comprising:

disposing a polymer layer onto the membrane material;

disposing a second porous catalyst layer onto a top portion of the polymer layer on the opposite side of the polymer layer as the membrane layer; and

disposing a cathode current collector onto portions of the second porous catalyst layer.

30. The method of claim 26, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.